

Payment will be made under:

Item No. 427	Emulsified asphalt slurry seal type ____ stone, Group II	Per square yard (meter)
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427.5.01 Adjustments

General Provisions 101 through 150.

Section 428—Micro Surfacing

428.1 Description

This work covers the materials, equipment, construction, and application procedures for placing micro-surfacing material for filling ruts and surfacing existing paved surfaces. Properly proportion, mix, and spread all ingredients on the paved surface according to this Specification and as directed by the Engineer.

428.1.01 Definitions

General Provisions 101 through 150.

428.1.02 Related References

A. Standard Specifications

Section 413—Bituminous Prime

Section 424—Bituminous Surface Treatment

Section 824—Cationic Asphalt Emulsion

B. Referenced Documents

GDT 125

428.1.03 Submittals

A. Invoices

When the Department requests, furnish formal written invoices from a supplier for all materials used in production of micro surfacing. Show the following on the invoice(s):

- Date shipped
- Quantity in tons (megagrams)

Purchase LRA-modified emulsion from a supplier who will provide copies of invoices upon the Department's request.

B. Mix Design

Submit the proposed mix design for approval at least two weeks before beginning the mixing operations. As a minimum, the design shall include the following:

- Aggregate test properties
- Aggregate target gradation
- Results of Table 1 mixture design properties
- Design percent asphalt residue based on dry weight of the aggregate
- Mineral filler percentages based on dry weight of the aggregate
- Quantitative effects of moisture content on the unit weight of the aggregate (bulking effect)

Submit to the Office of Materials and Research (OMR) representative samples of each ingredient to be used in the micro-surfacing mixture for design verification at least two weeks before beginning mixing operations. Include information about sources, type of materials, and project number.

Do not begin micro-surfacing work until the OMR has approved the micro-surfacing design and accepted the mixture.

The Engineer's acceptance of the design is solely for quality control and does not release the Contractor from performing acceptable work under this Specification.

Ensure the mixture has sufficient working life to allow for proper placement at the existing ambient temperature and humidity. Redesign the mixture if a constituent must be replaced, or gradation changed, in order to produce an acceptable mixture. Proportion the constituents to produce a uniform mixture meeting the requirements of Table 1.

Table 1—Mixture Design Properties

Micro-Surfacing		Type I	Type II
Mixture Control Tolerances	Grading Requirements	Percent Passing	Percent Passing
±0%	3/8-inch (9.5 mm)	100	100
±6%	No. 4 (4.75 mm)	90-100	60-95
±5%	No. 8 (2.36 mm)	65-90	45-75
±4%	No. 50 (300 µm)	20-45	15-35
±3%	No. 200 (75 µm)	5-15	5-15
	Design Requirements	Range	Range
±0.5%	Residual AC, %	6.0-9.0	6.0-9.0
N/A	Mineral Filler, %	0.5-3.0	0.5-3.0
Design Requirements – Micro Surfacing Type I and Type II			
Test No.	Description		Specification
AASHTO T-245 (Modified)	Flow		6-16
AASHTO T-245 (Modified)	Min. Stability, lb (kg), 50 Blow Marshall		1800 (8000)
ISSA TB-100	Wet Track Abrasion Loss (Maximum)	6-day soak	1 lb/yd ² (538 g/m ²)
		1-hour soak	1.5 lb/yd ² (807 g/m ²)
ISSA TB-147A or 147C	Vertical Displacement (Maximum)		10%
ISSA TB-109	Excess Asphalt by LWT (Maximum)		1 lb/yd ² (538 g/m ²)
ISSA TB-113	Mixing Time Test @ 100°F (38 °C) (Minimum)		45 Seconds
ISSA TB-139	Set Time Test (Minimum)	@ 30 minutes	12 kg-cm
		@ 60 minutes	20 kg-cm
ISSA TB-102	Water Resistance Test @ 30 Minutes		No Discoloration
ISSA TB-114	Wet Stripping Test (Minimum Retained)		90%
ISSA TB-115	System Compatibility		Pass

Note 1: Base percent residual asphalt and percent mineral filler on weight of the dry aggregate.

Note 2: Maintain the gradation and percent residual asphalt as shown on the micro-surfacing design or as established by the Engineer within the listed Mixture Control Tolerances. Meet mix control tolerances or make immediate adjustments to bring the gradation and percent residual asphalt back within tolerances, or the work will not be allowed to continue.

Note 3: Modify procedures stated in AASHTO T-245 for determining Flow and Marshall Stability to permit air drying of the mixture at 70 - 77 °F (21 - 25 °C) for 3 days before reheating and fabricating Marshall specimens.

428.2 Materials

The materials to be used and their specifications are listed below:

A. Aggregate

Use aggregate in micro-surfacing that meets the requirements of Subsection 802.2.02.

EXCEPTION: Aggregate shall be manufactured from Group II, Class A or B crushed stone or slag, and the Sand Equivalent Value shall not be less than 65 when tested according to AASHTO T-176.

Ensure that aggregates shipped to the project are uniform and do not require blending or pre-mixing at the storage area before use. Aggregates must meet the appropriate gradation as shown in Table 1 .

B. Mineral Filler

Use mineral filler that is Portland cement or hydrated lime which meets the following requirements:

Portland cement	Section 830 and 883
Hydrated Lime	Section 882 and 883

C. Cationic Asphalt Emulsion

Ensure that the emulsified asphalt is a cationic type CSS-1h(LRA) or CSS-1P that meets the requirements for CSS-1h of Section 824, modified to waive the cement-mixing test.

D. Latex Rubber Additive (LRA)

Ensure the LRA is a natural latex or an unvulcanized styrene-butadiene rubber in an emulsified latex form. Provide certification from the LRA manufacturer that the LRA meets the following requirements:

Rubber Solids content, Minimum %, ASTM D 1417	60 (by weight)
Brookfield Viscosity, cps Maximum, ASTM D 1417	5000
Total Ash, Maximum %, ASTM D 297	3.5

Co-mill the LRA and the special emulsifiers with the asphalt cement while manufacturing the emulsified asphalt to produce a homogeneous mixture. Add the LRA in the necessary proportions to result in 3% neat latex by weight of residual asphalt cement in the emulsion. Ensure the LRA modified emulsified asphalt, when left undisturbed for 24 hours, shows no separation of emulsion and LRA and no color striations, but has a uniform color throughout.

Ensure that the residue from the LRA modified emulsified asphalt has a minimum softening point of 135 °F (60 °C) when tested according to AASHTO T-53.

EXCEPTION: The maximum test temperature shall not exceed 350° F (176°C) and the duration shall not exceed 20 minutes.

Formulate the emulsified asphalt to allow the paving mixture to cure at a rate that will permit traffic on the pavement within 1 hour after application without damaging the pavement surface.

E. Bituminous Tack Coat

Use a cationic asphalt emulsion CSS-1h or CQS-1h for the bituminous tack coat that meets Section 824 and is diluted according to Subsection 428.3.05.D.

F. Water

Use water for the micro-surfacing mixture that is potable and free of contaminants detrimental to the mixture.

G. Other Additives

Provide other additives as required to control the set time of the mixture in the field.

428.2.01 Delivery, Storage, and Handling

A. Aggregate Storage

Store or stockpile mineral aggregates in a manner that will prevent segregation, mixing of the various materials or sizes, and contamination with foreign materials. Do not use construction equipment on, or to ramp the stockpiled aggregate. Pass the aggregate over a scalping screen immediately before transferring it to the micro-surfacing mixing machine to remove oversized material.

B. Storage of Bituminous Material

Ensure that the bituminous storage is adequate to meet the requirements of the production rate. Always keep clean all equipment used to store and handle bituminous material and operate it in such a manner to prevent contamination with foreign matter.

428.3 Construction Requirements

428.3.01 Personnel

General Provisions 101 through 150.

428.3.02 Equipment

Obtain the Engineer's approval for all equipment, tools, and machines used to perform this Work. Do not attempt work with malfunctioning equipment. The Engineer may stop the work if equipment and tools are not sufficient to place the materials satisfactorily.

A. Mixing Equipment

Blend the paving mixture using a self-propelled micro-surfacing mixing machine that is:

- A continuous flow mixing unit
- Able to accurately deliver and proportion the aggregate, LRA-modified emulsion, mineral filler, field control additives, and water to a revolving multi-blade, twin shafted mixer
- Able to Discharge the mixed product on a continuous flow-

EXCEPTION: Blending the paving mixture may be accomplished with a truck mounted micro-surfacing mixing machine that meets the above specification, except for continuous flow, when placing the mixture on short streets or projects that are less than one-half mile (800 m) in length.

For streets or projects less than one-half mile (800 m) in length, individual truck-mounted units may be used for placement of micro-surfacing. For streets or projects one-half mile (800 m), or greater, in length, place micro-surfacing mixture with a machine that is equipped as follows:

- Has self-loading devices that load raw materials while continuing to lay micro-surfacing, thereby minimizing construction joints
- Has opposite side driving stations to optimize longitudinal alignment
- Allows the operator to have full hydrostatic control of the forward and reverse speed while applying micro-surfacing material

Thoroughly blend the mixture so that no uncoated aggregate is visible upon discharge from the mixing unit or in samples taken from the roadway.

1. Water Pressure System

Use a mixing machine equipped with a water pressure system and nozzle-type spray bar to provide a water spray ahead of and outside the spreader box when required.

2. Proportioning Devices

Use a machine equipped with individual volume or mass controls or other gauging devices for measuring and proportioning each material added to the mix. Properly calibrate, mark, and positively interlock each material control device.

Ensure that the aggregate feed to the mixer is equipped with a revolution counter or similar device to determine the amount of emulsion used at any time. Before beginning the work, calibrate each mixing unit and provide a copy of the calibration worksheet to the Engineer. Once calibrated, do not change the aggregate and emulsion flows without the Engineer's approval. The water and additive may be adjusted in the field to control the mix properties to produce an acceptable mix.

3. Emulsion Pump

The emulsion pump shall be a heated, positive displacement type pump.

4. Spreading Equipment

Uniformly spread the micro-surfacing mixture using a mechanical-type spreader box attached to the mixer, equipped with paddles or other devices to agitate and spread the materials throughout the box. Use paddles that are designed to maintain sufficient turbulence in the mixture to prevent the material from setting-up in the box or causing side buildup and lumps. Provide a front seal to prevent loss of the mixture at the road contact surface.

Provide an adjustable rear seal to act as a strike-off. Maintain the spreader to prevent the loss of the paving mixture during surfacing super-elevated curves. Design and operate the spreader box and rear strike-off to achieve a uniform consistency and produce a free flow of material to the rear strike-off without causing skips, lumps, or tears in the finished surface. Use a spreader box capable of lateral movement or with side-shift abilities to ensure proper alignment with the roadway.

B. Auxiliary Equipment

Provide a pressure distributor, power-broom, and power blower which meets requirements of Subsection 424.3.02.

Provide suitable crack and surface cleaning equipment, barricading equipment, hand tools, and other support equipment necessary to perform the work.

428.3.03 Preparation

General Provisions 101 through 150.

428.3.04 Fabrication

General Provisions 101 through 150.

428.3.05 Construction

A. General

Produce, transport, and place the specified materials according to these specifications and as approved by the Engineer. Produce a finished micro-surfacing that has a uniform texture free from excessive scratch marks, tears, or other surface irregularities. Ensure that the cured mixture fully adheres to the underlying surface. Based on a visual examination or test results, the Engineer may reject any work due to poor workmanship, loss of texture, raveling, or apparent instability.

B. Weather Limitations

Spread the micro-surfacing mixture only when:

- The ambient temperature for 48 hours immediately prior to placement has been at least 50 °F (10 °C).
- The current pavement surface and the ambient temperature is at least 50 °F (10 °C) and rising. Supply a surface temperature thermometer and a sling psychrometer and take temperature and humidity measurements as directed by the Engineer.
- The weather is not foggy or rainy.
- There is no forecast of temperatures below 32 °F (0 °C) within 48 hours from the time of placement.

Whenever the relative humidity exceeds 80 percent or the weather is overcast, the placement of micro-surfacing will be at the discretion of the Engineer.

C. Surface Preparation

Before applying the micro-surfacing mixture, thoroughly clean all cracks and the area to be surfaced to the Engineer's satisfaction.

D. Tack Coat

Use a tack coat which consists of cationic asphalt emulsion CSS-1h or CQS-1h. Dilute it at the rate of one part emulsion and three parts water, and apply with an asphalt distributor. The application rate is 0.05 to 0.10 gal/yd² (0.23 to 0.45 L/m²) of diluted emulsion per square yard (meter). Apply the tack coat according to Section 413. If the surface course is

placed within 30 days of the leveling course or if the Engineer determines that excessive tracking of material is evident, a tack coat will not be required between the leveling and surface course.

E. Application

Pre-wet the surface by spraying water ahead of and outside of the spreader box at a rate that dampens the surface without allowing water to flow freely ahead of the spreader box.

Spread the paving mixture on the prepared surface to produce a uniform finished surface. Take care when filling ruts to restore the designed profile of the pavement cross section. Excess crowning or overfilling of the rut area is not permitted. Use squeegees and lutes to spread the mixture in areas inaccessible to the spreader box and areas requiring hand spreading. Carry a sufficient amount of material at all times in all parts of the spreader box to ensure complete coverage.

Make adjustments to the additive, if necessary, to provide a slower setting time during hand spreading. If hand spreading is necessary, pour the mixture in a small windrow along one edge of the surface to be covered and uniformly spread with a hand squeegee or lute. Provide a smooth, neat seam where two passes meet. Immediately remove excess material from the ends of each run.

F. Traffic Control

Do not allow traffic on the micro-surfacing mixture until it has cured sufficiently to prevent pick up or marring of the surface. Repair any damage done by traffic to the mixture at no expense to the Department.

G. Rut Filling and Leveling (Scratch) Course

When required on the Plans, provide micro-surfacing materials to fill ruts, utility cuts, depressions in the existing surface, etc. before the final surface course is placed. When ruts are no more than 1/2 inch (13 mm) in depth, construct the leveling/scratch course using a full width spreader box with a steel strike-off. Fill ruts deeper than 1/2 inch (13 mm) independently with a rut-filling spreader box, 6 ft (1.8 m) in width, or as directed by the Engineer.

Place and open to traffic the rut filling and leveling (scratch) course at least 24 hours before surfacing.

H. Workmanship

Excessive buildup, uncovered areas, or unsightly appearance are not permitted on longitudinal or transverse joints. Place longitudinal joints on lane lines. Excessive overlap is not permitted. Ensure straight lines along the roadway centerline, lane lines, shoulder, or edge lines. Keep lines at intersections straight to provide a neat and uniform appearance.

1. **Finished Surface:** Ensure that the finished micro-surfacing has a uniform texture free of excessive scratch marks, tears, or other surface irregularities. Excessive tear marks are considered 4 marks that are 1/2 inch (13 mm) wide or wider and 6 inches (150 mm) or more long per 100 square yards (85 meters), or any marks 1 inch (25 mm) wide or wider or 4 inches (100 mm) long. Ensure that the edges of the micro-surfacing appear neat and that longitudinal alignment is parallel to the roadway centerline.
2. **Joints and Seams:** Produce neat and uniform longitudinal and transverse joints. Construct transverse joints as butt-type joints. Place longitudinal joints on lane lines when possible. Do not allow gaps between applications. Joints are acceptable if there is no more than a 1/2 inch (13 mm) vertical space for longitudinal joints nor more than 1/4 inch (6 mm) for a transverse joint between the pavement surface and a 4 ft (1.2 m) straightedge placed perpendicular on the joint.
3. **Areas the Mixing Machine Cannot Reach:** Surface these areas using hand tools to provide complete and uniform coverage. Clean and lightly dampen the area to be handworked before placing the mix. Ensure areas that require handwork produce a finished surface that is uniform in texture, dense, and has a neat appearance similar to that produced by the spreader box. Micro-surfacing material required to repair deficiencies due to unsatisfactory workmanship and the work required to mix and place the materials according to the Specifications, will be provided at no expense to the Department.

428.3.06 Quality Acceptance

Take two samples of mixture for determining quality acceptance for each day of operation. Test the second sample only if the results of the first sample are outside mixture control tolerances. Test the samples according to GDT 125. The deviation in test results from the Job Mix Formula will be used to determine compliance with the mixture control tolerances. If more than one sample is tested, the average deviation shall be used to determine compliance.

A mixture adjustment period will be provided during the first two days of operation. If the average deviation of sample results for the first day are outside the mixture control tolerances, you may adjust equipment settings to provide a mixture within the tolerances. Samples will be taken the second day (after equipment changes, if any, have been made) and the average deviation in test results will be calculated. If the average deviation of test results for the second day is within mixture

control tolerances, mixture quality will be accepted for the first two days of operation. If the average deviation from the second day is not within mixture control tolerances for percent residual asphalt content, a 2% reduction in unit price will be assessed for each 0.1 percent the residual asphalt content is outside the mixture control tolerances for each of the first two days that tolerances were exceeded.

A. Emulsified Asphalt

Maintain the percent residual asphalt and gradation as shown on the micro-surfacing design, or as established by the Engineer, within the Mixture Control Tolerances listed in Table 1.

After the adjustment period, a 2% reduction in unit price will be applied for each 0.1 percent the residual asphalt content is outside the Mixture Control Tolerance given in Table 1 for the day's production represented by the sample. The average deviation of the samples will be used to determine conformance to the Mixture Control Tolerance. Do not continue to operate and place materials outside the mixture control tolerances. Adjust the placement operation as necessary to maintain production within the tolerances given.

B. Aggregate Application Rate

Control the target spread rate for micro-surfacing to within plus or minus 2 lbs/yd² (1 kg/m²) of the spread rate specified in the Proposal based on the weight of dry aggregate. Mix placed in excess of the upper spread rate tolerance will not be paid for. The unit price will be reduced by 5% for each pound (0.5 kg) of aggregate per square yard (meter) less than the spread rate tolerances established above for each day's placement of material. Accept pay reduction for deficient daily production, or overlay the deficient area at full plan width and depth at the Contractor's expense. Do not continue to operate and place materials outside the spread rate tolerances. Adjust the placement operation as necessary to maintain production within the tolerances given.

428.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

428.4 Measurement

A. Micro-Surfacing

Micro-Surfacing, Type I or II surface course, is measured and accepted as completed by the in-place square yard (meter). In computing square yards (meters), the lengths and widths used shall be as specified in Section 109, "Measurement and Payment".

B. Leveling (Scratch Course)

A leveling (scratch course) is measured and paid for by the ton (megagram) of dry aggregate used. Tons (megagrams) of aggregate used shall be determined using the total daily revolutions of the aggregate feed belt and the corresponding gate setting and weight per revolution shown on the mixing unit calibration worksheet.

C. Tack Coat

Diluted emulsified tack coat is measured and paid for according to Section 413.

428.4.01 Limits

General Provisions 101 through 150.

428.5 Payment

Micro-surfacing will be paid for at the contract unit price, which is full compensation for furnishing all materials, including LRA modified bituminous materials, and for furnishing all equipment, work, and labor.

Payment will be made under:

Item No. 428	Micro-Surfacing, type I	Per square yard (meter)
Item No. 428	Micro-Surfacing, type I leveling	Per ton (megagram)
Item No. 428	Micro-Surfacing, type II	Per square yard (meter)
Item No. 428	Micro-Surfacing, type II leveling	Per ton (megagram)

428.5.01 Adjustments

General Provisions 101 through 150.